

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Currently amended) A thermally conductive composite material for reducing electromagnetic emissions generated by an electronic device, said thermally conductive composite material comprising ~~in combination~~:

a thermally conductive material in particulate form; and

an electromagnetic-energy-absorptive material in particulate form,

said thermally conductive material and said electromagnetic-energy-absorptive material being suspended within a polymeric base material, said polymeric base material being substantially transparent to electromagnetic energy, said polymeric base material comprising a phase-change material and up to 20% by weight of ethylene-vinyl acetate, the phase-change material comprising a paraffin wax, a synthetic wax, or equivalents thereof, wherein the phase-change material has a reflow temperature that allows the thermally conductive material in particulate form that is suspended within the polymeric base material to flow into gaps and thereby at least reduce thermal impedance.

wherein said thermally conductive composite material is configured such that when placed between an electronic device and a proximate structure, said thermally conductive material is operable for facilitating facilitates transfer of thermal energy from said electronic device and said electromagnetic-energy-absorptive material is operable for reducing reduces electromagnetic emissions generated by the device, and

wherein the electromagnetic-energy-absorptive material includes carbonyl iron.

2. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein at least one of said thermally conductive material and said electromagnetic-energy-absorptive material comprises particles in the form of granules having a spheroid shape.

3. (Cancelled)

4. (Original) A thermally conductive composite material as claimed in claim 1 wherein said thermally conductive material is selected from the group consisting of aluminum nitride, boron nitride, iron, metallic oxides and combinations thereof.

5. (Original) A thermally conductive composite material as claimed in claim 1 wherein said thermally conductive material is a ceramic material.

6-8. (Canceled)

9. (Original) A thermally conducting composite material as claimed in claim 1 wherein said polymeric base material has a relative dielectric constant of less than approximately 4 and a loss tangent of less than approximately 0.1.

10. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material is selected from the group consisting of elastomers, natural rubbers, synthetic rubbers, PDP, EPDM rubber, and combinations thereof.

11. (Canceled)

12. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material is selected from the group consisting of silicone, fluorosilicone, isoprene, nitrile, chlorosulfonated polyethylene, neoprene, fluoroelastomer, urethane, thermoplastics, thermoplastic elastomer (TPE), polyamide TPE, thermoplastic polyurethane (TPU), and combinations thereof.

13. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material is a solid material selected from the group consisting of thermoplastic and thermosetting materials.

14. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material is a liquid.

15. (Original) A thermally conductive composite material as claimed in claim 14 wherein said liquid is selected from the group consisting of silicones, epoxies, polyester resins, and combinations thereof.

16. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a phase-change material configured to exist in a solid phase at ambient room temperature and transition to a liquid phase at a reflow temperature.

17. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of a paraffin wax and an ethylene-vinyl acetate copolymer.

18. (Original) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a synthetic wax having a melting point of approximately 100 °C and a molecular weight of approximately 1000.

19. (Original) A thermally conductive composite material as claimed in claim 1 wherein said electromagnetic-energy-absorptive material has a relative magnetic permeability greater than about 3.0 at approximately 1.0 GHz and greater than about 1.5 at 10 GHz.

20. (Original) A thermally conductive composite material as claimed in claim 1 wherein said composite material is in the form of a sheet having a thickness greater than approximately 0.01 inches.

21. (Original) A thermally conductive composite material as claimed in claim 1 wherein said composite material is in the form of a sheet having a thickness less than approximately 0.18 inches.

22. (Original) A thermally conductive composite material as claimed in claim 1 wherein said composite material is in the form of a sheet, and further comprises an adhesive on at least one side of said sheet.

23. (Original) A thermally conductive composite material as claimed in claim 22 wherein said adhesive is a thermoconductive adhesive.

24. (Original) A thermally conductive composite material as claimed in claim 22 wherein said adhesive is a pressure-sensitive, thermally conductive adhesive.

25. (Original) A thermally conductive composite material as claimed in claim 22 wherein said adhesive is based on compounds selected from the group consisting of acrylics, silicones, rubbers and combinations thereof.

26. (Original) A thermally conductive composite material as claimed in claim 22 wherein said adhesive further comprises a ceramic powder.

27. (Currently amended) A method of reducing electromagnetic emissions produced by a device comprising:

combining a thermally conductive material in particulate form with an electromagnetic-energy-absorptive material in particulate form, the electromagnetic-energy-absorptive material including carbonyl iron;

suspending the combined thermally conductive material and electromagnetic-energy-absorptive material in a polymeric base material comprising a phase-change material and up to 20% by weight of ethylene-vinyl acetate, the phase-change material comprising a paraffin wax, a synthetic wax, or equivalents thereof; and

placing the combined thermally conductive material and electromagnetic-energy-absorptive material suspended in the polymeric base material between said device and a proximate structure, wherein the phase-change material has a reflow temperature that allows the thermally conductive material in particulate form suspended within the polymeric base material to flow into gaps and thereby at least reduce thermal impedance between the device and the proximate structure.

28-29. (Canceled)

30. (Original) The method of claim 27 wherein the proximate structure comprises a heat sink.

31. (Original) The method of claim 27 wherein said device comprises an integrated circuit.

32. (Previously Presented) The method of claim 27 wherein:
the combined thermally conductive material and electromagnetic-energy-absorptive material suspended in the polymeric base comprise a liquid solution; and
placing comprises applying the liquid solution onto a surface of at least one of the device and the proximate structure having one or more surface imperfections, and allowing the liquid solution to flow into the one or more surface imperfections.

33. (Previously Presented) The method of claim 27 wherein:
the combined thermally conductive material and electromagnetic-energy-absorptive material suspended in the polymeric base comprise a liquid solution; and
placing comprises spraying or painting the liquid solution onto a surface of at least one of the device and the proximate structure.

34. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein the electromagnetic-energy-absorptive material includes generally ellipsoidal carbonyl iron granules.

35. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein the electromagnetic-energy-absorptive material is entirely carbonyl iron.

36. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein:

the electromagnetic-energy-absorptive material exhibits better thermal conductivity than air; and

the thermally conductive material exhibits greater thermal conductivity than the electromagnetic-energy-absorptive material, the thermally conductive material having a thermal impedance value substantially less than that of air.

37. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein the composite material includes about 60 percent by volume of the thermally conductive material and the electromagnetic-energy-absorptive material.

38. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein:

the composite material is in the form of a sheet having a thickness of about 0.125 inch and exhibits an attenuation of at least about 5 dB in a frequency range from about 5 GHz up to at least about 18 GHz; or

the composite material is in the form of a sheet having a thickness of about 0.02 inch and exhibits an attenuation of at least about 3 dB for a frequency range extending upward from about 10 GHz; or

the composite material is in the form of a sheet having a thickness of about 0.04 inch and exhibits an attenuation of at least about 10 dB in a frequency range from about 9 GHz up to at least about 15 GHz and an attenuation of at least about 6 dB in a frequency range extending upward from about 15 GHz; or

the composite material is in the form of a sheet having a thickness of about 0.060 inch and exhibits an attenuation of at least about 5 dB in a frequency range extending

upward from about 4 GHz, having a greater attenuation of at least about 10 dB in a frequency range from about 6 GHz up to at least about 10 GHz.

39. (Previously Presented) A thermally conductive composite material as claimed in claim 1 wherein:

the thermally conductive material in particulate form comprises granules spaced-apart from each other;

the electromagnetic-energy-absorptive material in particulate form comprises granules spaced apart from each other and spaced-apart from the granules of the thermally conductive material; and

the composite material is electrically non-conductive.

40. (Previously Presented) A thermally conductive composite material as claimed in claim 2 wherein the thermally conductive material comprises microspheres.

41.-50. (Cancelled)

51. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of 25 parts by weight of a paraffin wax and 6 parts by weight of an ethylene-vinyl acetate copolymer.

52. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of 95 parts by weight of a paraffin wax and 5 parts by weight of an ethylene-vinyl acetate copolymer.

53. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of a paraffin wax and an ethylene-vinyl acetate copolymer, including an amount of the paraffin wax within a range of about 25 parts to about 95 parts by weight and an amount of ethylene-vinyl acetate copolymer within a range of about 5 parts to about 6 parts by weight.

54. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of a paraffin wax in an amount of about 80% by weight and an ethylene-vinyl acetate copolymer in an amount of about 20% by weight.

55. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of a paraffin wax in an amount of about 95% by weight and an ethylene-vinyl acetate copolymer in an amount of about 5% by weight.

56. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of a paraffin wax in an amount of between about 80% and about 95% by weight and an ethylene-vinyl acetate copolymer in an amount of between about 5% and about 20% by weight.

57. (New) A thermally conductive composite material as claimed in claim 1 wherein said polymeric base material comprises a mixture of paraffin wax having a melting point of approximately 51 degrees Celsius and a 28% ethylene-vinyl acetate copolymer having a melting point of approximately 74 degrees Celsius.

58. (New) The method of claim 27 wherein said polymeric base material comprises a mixture of 25 parts by weight of a paraffin wax and 6 parts by weight of an ethylene-vinyl acetate copolymer.

59. (New) The method of claim 27 wherein said polymeric base material comprises a mixture of 95 parts by weight of a paraffin wax and 5 parts by weight of an ethylene-vinyl acetate copolymer.

60. (New) An electronic component comprising an integrated circuit, a heat sink, and the composite material of claim 1.